Training Monitoring Engagement: An Evidence-Based Approach in Elite Sport

Original Investigation

Abstract

Purpose: Poor athlete buy-in and adherence to training monitoring systems (TMS) can be problematic in elite sport. This is a significant issue, as failure to record, interpret, and respond appropriately to negative changes in athlete wellbeing and training status may result in undesirable consequences, such as maladaptation and/or underperformance. This study examined the perceptions of elite athletes to their TMS, and their primary reasons for non-completion. ***Methods:*** Nine national team sprint athletes participated in semi-structured interviews on their perceptions of their TMS. Interview data was analysed qualitatively, based on grounded theory, and TMS adherence information was collected. ***Results:*** Thematic analysis showed that athletes reported their main reason for poor buy-in to TMS was a lack of feedback on their monitoring data from key staff. Further, training modifications made in response to meaningful changes in monitoring data were sometimes perceived to be disproportionate, resulting in dishonest reporting practices. ***Conclusions:*** Perceptions of opaque or unfair decision-making on training programme modifications and insufficient feedback were the primary causes for poor athlete TMS adherence. Supporting TMS implementation with a behavioural change model that targets problem areas could improve buy-in and enable limited resources to be appropriately directed.

Keywords: high-performance, athlete feedback, adherence, behaviour change, wellbeing.

Introduction

An effective training monitoring system (TMS) can positively influence performance through monitoring programme effectiveness and reducing the risk of illness or injury.[1] However, successfully implementing a TMS can be problematic in elite sport, with issues relating to end-user buy-in and a reticence to use scientifically validated measures.[2,3] This discrepancy between what research advocates and what happens in practice underlines the importance of providing elite sport with feasible, valid training monitoring strategies and solutions to facilitate optimal performance and mitigate athlete maladaptation.[4]

Recent guidelines for applied sport practitioners (scientific or medical staff) have suggested specific approaches to overcome some of the issues surrounding training monitoring.[5] However, an extension of these guidelines is necessary as many sports have customised, often un-validated TMS.[3] While it may be scientifically desirable to replace un-validated TMS, careful thought is required on whether it is practically achievable, as this may mean disregarding years of accumulated data. An alternative, which may be more palatable but challenging to achieve, is to address the concerns a custom TMS

poses in-situ by assessing their reliability and validity.[5] Despite the use of a custom TMS, elite sports face significant challenges developing commitment and buy-in from end-users to TMS. In light of these challenges, expanding existing guidelines[5] to include strategies to promote buy-in and deal with existing TMS problems would further support elite sports in optimising their TMS.[6]

By understanding the perspectives of end-users, new evidence-based strategies can be developed to improve user engagement. TMS buy-in and success is more likely when these opinions are addressed, as they can influence buy-in more than the objective benefits of the TMS alone.[6] Research has begun to explore what end-users want from a TMS,[7,8] but only a small number of elite athletes' opinions have been gathered.[2,9] This research has highlighted athletes' need for a user-friendly, cross-platform compatible interface that is not burdensome to complete; however, it has also identified a worrying trend for dishonest or careless reporting in order to meet the sport's adherence requirements.[2,10]

Practitioners are often the driving force behind TMS,[3] with their scientific knowledge and inter-personal skills relied upon to make the TMS a success.[11] However, there is little or no published evidence of the elite sector using theoretical behaviour change models to support practitioners in the adoption of TMS, despite the hurdles faced during its implementation. This lack of behaviour change underpinning is surprising given that multiple frameworks and taxonomies for behaviour change, its stages and interventions have been proposed.[12] Recently, researchers have advocated a social ecological approach when implementing TMS,[2] but there does not yet appear to be published evidence of this in practice. The Behaviour Change Wheel,[14] an ecological framework for implementing behaviour change interventions could instead provide elite sport with a structured approach to enable selection of appropriate interventions and guide their subsequent implementation.

This study aimed to explore the views of a group of elite athletes who use a TMS and, using an inter-disciplinary and mixed-methods approach, utilise this information to inform intervention strategies to support TMS buy-in.

Methods

Participants

Recruited through convenience sampling, 9 national team female sprint water-sport athletes agreed to take part in this study. The mean age of the athletes was 23.7 ± 2.5 years, with 3.8 ± 2.5 years of their careers spent on a nationally-funded elite programme. All athletes were fully informed, in writing, of the risks and benefits associated with participation, their anonymity was assured and

informed consent was gained. Ethical approval was granted through the University of Winchester Ethics Committee.

Design

Following an education session on the TMS, athletes recorded daily wellbeing and training monitoring logs for 12 months in a bespoke online platform, while adhering to their normal training programme. Following the 12-month period of engagement with the TMS, all 9 athletes were invited to complete a short questionnaire, followed by one-to-one interviews with the primary researcher.

Method

Quantitative information on adherence rates were extracted from the TMS dataset. Due to the 2016 Olympic Games, some athletes were not required to complete their monitoring information over the entire 12-month period. Where relevant, this has been indicated in the results.

Using a grounded theory approach, semi-structured interview guides (Appendix B) were developed to aid discussion and allow novel insights to emerge.[15] Interviews ranged from 14–27 min in length and were digitally audio-recorded, transcribed verbatim, and then re-checked for accuracy. The interviews commenced with athletes completing a brief questionnaire Appendix A to provide a platform for elaboration within the interview. This was followed by a discussion on the athletes' views on training monitoring practices within their sport

Data Analysis

The questionnaire results were collated and interview data were analysed thematically, with NVivo 11 Pro (QSR International Pty Ltd., Doncaster, Australia) used to code the interview data. Using an inductive approach, meaningful units of text were attributed to themes and subsequently coded to nodes.[15] This process was repeated multiple times and the nodes evolved to ensure the questionnaire results were accurately reflected. The nodes were subsequently grouped into lower and higher order themes (Table 1). Finally, athletes were sent the transcribed versions of their interviews and the coded themes. Any comments raised were then considered in the construction of the final thematic analysis.

Results

Of the athlete's interviewed, 78% were either undecided or disagreed that they received enough feedback from their TMS data (Figure 1a). A further 56% either disagreed or were undecided on whether action was taken when meaningful changes in TM (training monitoring) scores occurred (Figure 1b). The majority of respondents stated that they were honest in their TM responses, with one athlete indicating that they were not (Figure 1c). However, 44% of respondents either agreed or strongly agreed that TM feedback helped optimise their training and performance, with 56% undecided (Figure 1d).

******************Figure 1 about here*******************

Higher and sub order themes are summarised in Table 1 along with the number of meaning units coded from the interview transcripts. The most discussed theme related to feedback and subsequent actions. When the examples of these were analysed, the majority of the remarks were classed as ineffective examples of feedback. Under the Education and Awareness theme, the majority of comments demonstrated a lack of understanding in relation to TM. A comparison of negative and positive reflectivity and ownership under the Athlete Approach theme showed that over half were negative comments.

******************Table 1 about here*******************

Adherence

Adherence completion rates in the year leading up to the interviews were 62 ± 20%. This figure has been amended to reflect that, due to the competition cycle, 3 of the 9 athletes were not required to complete their monitoring from June 2016 until the August 2016 Olympic Games. Adherence was a high order theme, with athletes making many references to both experiences that have promoted (16 Meaning Units, M.U.) see Table 1, and reduced their adherence to TM (12 M.U.):

> My adherence has been terrible, like full-stop, because when we started (TM) nothing was done with the information. It had no benefit to my training.

Some athletes failed to see the benefit or value of TM unless there was visible use of the information, consequently their adherence was negatively impacted. However, when the feedback loop was completed, and athletes had confidence in the process, the opposite was true:

> I was in the routine of doing it (TM), and I knew there would be holes in it if I didn't do it, and it motivated [me] to carry on, because I knew I'd see it back.

Athletes made frequent references to initial difficulties in establishing the habit of completing TM, but how, with time, it formed part of their normal training routine. Disruptions to their normal routine, such as camps or competitions, were reported to negatively impact adherence. Sport-imposed consequences for non-adherence were negatively viewed, with a perception that the consequences weren't consistently applied, that they tailed off during the season, and that they could usually be evaded.

Athlete Approach

Athletes demonstrated varied engagement with TM, from actively disliking it, through to being indifferent or transactional:

> If they're still giving the feedback, then we're happy to continue. Whereas if they stopped giving the feedback you stop doing it, it just kind of becomes this. Like well you don't do anything so I'm not going to bother. But if they continue to keep looking and checking, we're happy to keep filling it in.

Or, at the other end of the spectrum, demonstrating self-reflection and engagement with the information:

> I think as I have grown as athlete actually learnt, actually realised that actually I can be using this into my own kind of needs and benefits and stuff like that, I think now I understand it and use it a bit more in my own processes.

Athletes indicated that they were usually truthful in their TM reporting. However, some said they were prone to alter their responses during hard training weeks "to try and make you believe you're better than what you are," or if they felt their true response might lead to them being removed from training. Four athletes also felt that the TM process served as negative reinforcement of their fatigue levels, and this was a particular concern during competitions, despite a recognition that the data during that time would be useful.

Education and Awareness

It was clear that some athletes lacked an understanding of the purpose and benefits of TM, with 8 out of 9 athletes having comments coded to this theme:

> The coaches do pick up any injuries or anything, and that's why it's sometimes a bit like they already know we've got something sore if we talk to them. Why do we need to put it on this?

This lack of clarity was exacerbated by some athletes indicating that they were unsure how to best report, interpret, or electronically access information on the online platform. In particular, they found the reporting of the rating of perceived exertion (RPE) and session duration for time trials or during competition problematic, indicating that the calculated session RPE was not always representative of the actual training load they experienced. In contrast, some athletes revealed a deeper understanding of the purpose of TM, demonstrating self-reflective behaviours or indicating they could recognise meaningful patterns:

> Well I think when it comes to injuries it's quite useful. You can kind of, sometimes you can notice a pattern or there is like something creeping up then you would say oh actually this has happened before.

Feedback and Act

Athletes identified a broad range of feedback preferences, favouring visual feedback supported by formal or informal discussions. Preferred feedback frequency ranged from weekly to monthly, with a mean of 25 days across all athletes. Athletes were however critical about the feedback and actions taken in light of TM data. Feedback frequency and timing did not appear to meet athlete expectations, with some athletes indicating that they believed the data was not looked at:

> In the beginning when we started using it, nothing came of it, so we'd be filling this thing out. And then you'd come in in the morning and they're like so "how are you today?", and like well if you'd have just read the thing I've already filled out, we wouldn't have to have this conversation. They obviously didn't read it.

Other athletes mentioned that as they had not been unwell they had not received any feedback and the TM information was therefore not useful to them. One athlete also underlined the importance of linking the wellbeing monitoring data back to training load in order to get a holistic picture of their

status. Several athletes reported positive benefits from both formal or informal discussion and exploration of their TM data with staff. Those athletes that indicated they could perceive value in TM gave examples of where the data had been used to benefit their training and recovery:

> I think because they've started applying it to training a bit more, like the actual programme, so they'll check that what you've put in is your perceived kind of output for the week, matches what they wanted…and that they'll actually talk to you about it and give you a bit of feedback.

Athletes had contrasting views about actions taken based on TM data. Some felt that disproportionate responses were taken when negative changes in TM data were observed, or that the scientific robustness behind some of the decisions was questionable:

> Because if you're tired, and you put tired down, they go oh you're too tired today, and I'm like I'm not too tired. There's tired and then where's the limit…as an athlete you don't want to be told not to train.

Whereas others felt no action was taken when TM scores changed:

> I've been putting like high fatigue, high fatigue a long time before I'm ill, and it doesn't tend to get hugely picked up on.

The TM data appeared to prove particularly useful for athletes who perceived they were on the verge of an illness and aided them in identifying 'niggles' before they became significant issues. Overall the athletes depicted a process that worked inconsistently.

Planning and Design

The majority of athletes (56%) completed monitoring in addition to what was required by their sport. Additional monitoring most commonly comprised training diaries where technical and subjective information was recorded, food diaries, GPS and/or heart rate data.

A range of technical issues with the mobile application were apparent, including sign-in issues, the absence of a cross-platform mobile application and problems integrating and accessing the key summary information. Athletes suggested a variety of methods to improve the TM process. These included linking athlete self-report measures and training load data, and ensuring historical information was accessible and well presented. They also requested that the daily use and feedback

of TM information became more visible, and that the sport consider allowing athletes the option of picking one question each to allow more ownership over the TM process. Some athletes requested rephrasing questions to allow comparisons to "normal," as they felt this would give a better indication of meaningful change.

Discussion

Research has provided insights into the scientific and technological components of a successful TMS, (e.g. measure reliability/validity, specificity and ease of use).[1,5] While perhaps intuitive, less has been published on how to achieve desirable behaviours in athletes using a TMS (e.g. consistent, honest reporting). Based on a cohort of elite athletes' perspectives, this study has focussed on exploring which factors may improve or impair TMS implementation. The primary concerns reported were: disproportionate training modifications in response to meaningful changes in TMS data, and a lack of athlete feedback.

When meaningful change was identified in their feedback, some athletes expressed concerns about inconsistent or disproportionate training modifications made by staff (Figure 1b). This is perhaps unsurprising given the lack of consensus of what constitutes meaningful change.[16] For some athletes (Figure 1c) these concerns gave rise to dishonest reporting in order to circumvent their potential removal from training. Previously, dishonest reporting has only been described where punishments were imposed for poor adherence.[2] Custom un-validated TMS may be at more risk of these behavioural problems as their ability to detect meaningful change is usually unknown. Nonetheless, building a culture of trust with athletes through agreed, transparent and proportionate responses to TM data is likely to help combat these issues.

Feedback on their TMS data was reported to be highly valued by all athletes, particularly when it was contextualised and related to training load. This finding was clearer in interview data than the questionnaires (Figure 1a) with the inconsistent results potentially attributable to misinterpretation of questionnaire prompts, or more emotive responses occurring within interviews.[17] Some athletes stated that failure to receive TMS feedback negatively impacted their adherence and perception of TMS efficacy. Previous research has recognised the need for athlete feedback in a TMS,[9,18] but the powerful transactional relation between adherence and feedback expressed by the athletes, while perhaps unsurprising, has only previously been reported with regards to a sports health surveillance system.[9] This highlights the need for sports to ensure that their feedback processes for TMS are practical and that they facilitate the exchange of feedback between staff and athletes.[5]

When asked how frequently they would like to receive feedback, athletes in this study indicated that every 25 days was acceptable. This was, however, contradicted by feelings of irritation and their perceptions of feedback being ineffective if their daily changes in wellbeing were not scrutinised (Table 1). Obtaining feedback frequency statistics could shed light on these contradictory findings, but as feedback frequency is not indicative of quality, this still may not give a comprehensive picture of how feedback influences adherence.[19]

While the need for feedback is becoming increasingly evident, what constitutes acceptable feedback content and frequencies in order to maintain adherence is currently not well described. Previously it has been reported that the majority of elite sports collected (55%) and provided feedback (42%) to athletes on TMS data daily,[3] but whether or not this feedback rate positively impacted adherence was not reported. Further, while athlete feedback has been deemed important by recent research,[9] details on the desired frequency or content of feedback have not been outlined. Therefore, in order to preserve TMS buy-in, sports should consider a balance between satisfying the need for athlete requested feedback frequencies, which athletes may under-represent, and the staff workload required for daily feedback.[1,5,20] Furthermore, the content of feedback should contextualise patterns (current vs. historical) and meaningful changes, in order to promote athlete self-reflection.

Despite athlete education sessions preceding TMS implementation, athletes reported that they were unsure how to access and interpret their results. Contrary to previously reported data,[21,22] athletes also stated that session RPE misrepresented their training loads during time trials and competitions and/or reinforced their fatigue levels. Where this occurs, maintaining the confidence of the athletes in the TMS through discussion of the perceived shortcomings of session RPE and agreeing how to tackle them, e.g. standardised accepted session durations/ratings, and agreed monitoring frequencies around sensitive times (such as competition) may help maintain athlete adherence.

Many athletes also felt that there was a mismatch in feedback expectations between themselves and staff, and that they were unsure of the purpose of the TMS in relation to their performance (Figure 1d). Perhaps as a result of this poor understanding, which has been reported elsewhere,[9] athletes indicated that they had modified their TMS scores to improve their own perception of wellbeing.

As education sessions are a tool frequently utilised to improve intervention efficacy in elite sport,[23] it may be advisable to review the value of this intervention and to explore additional or alternative methods, such as incentivisation, policy changes, or utilising experienced athletes to mentor new recruits and model expected behaviours. Behaviour change models can provide further guidance.[24]

Poor user-experience, a failure to integrate subjective and objective data and to visualise historical data can cause athletes to become disengaged from TMS use. As discussed elsewhere[2,5], these issues need to be overcome to provide a basic foundation for a serviceable TMS. To promote continued engagement with the TMS it is advisable for it to become routinely utilised within the sport. Performance reviews, video/technical analysis, (in)formal coach/athlete discussions, scheduling and routine training programming, can provide avenues to regularly interact with the TMS.[7] Exploring the use of personalised questions for athletes, incorporating behaviour change theory, promoting reflective behaviours and providing information and advice through the TMS may further support engagement.[25]

As multiple barriers to TMS implementation have been reported,[2] the next step in TMS evolution may be the application of the methodical approach that a theoretical behaviour change model can provide. While primarily targeting athlete behaviours, there may be utility in broadening the scope of any behaviour change strategy to include other staff members.[2,14] Behaviour change models could help identify the most effective methods to enhance TMS buy-in, potentially saving time, money and political goodwill.[26] Furthermore, an underpinning theory-driven strategy to promote successful TMS implementation has the potential to support TMS buy-in further through increased intervention effectiveness.[12]

A recent research focus on TMS has produced evidence for its utility in reducing injury/illness risk[27] and barriers to implementation.[2] A broad multi-level approach has been suggested to combat these barriers[2] and, where possible, this is advisable. However, resource limitations in elite sport may dictate a more targeted approach. Through understanding what factors significantly impact athletes' engagement with TMS, targeted interventions to promote TMS use and behaviour change can be used, thus reducing the time and resource burden of a broader multi-level approach.[26] A periodised approach to both TMS use, the provision of feedback and the interventions employed may help alleviate 'at risk' periods of poor adherence, e.g. during competitions.

Conclusion

When completed honestly, consistently, and in line with expectations, training monitoring information can trigger wider conversations to support prevention of illness/injury and optimise performance. However, behavioural issues highlighted in this study may prevent this from occurring unless addressed with appropriately timed and selected interventions. If TMS implementation is planned alongside behaviour change tools this could reduce the need to rely on the inter-personal skills of

practitioners to promote TMS buy-in, lessening the time and resource burden commonly encountered when implementing a new TMS.[5,26,28] The use of a planned and periodised approach to TMS use, feedback and intervention implementation may further support the successful use of TMS.

Practical Applications

Integrating the use of TMS into daily practice through methods such as coach discussion and video analysis should support athletes engage with TMS. Undertaking a periodised approach to TMS use and feedback, whilst also ensuring clear expectation management on TMS capabilities, use and feedback frequency could further help practitioners maintain buy-in from athletes.

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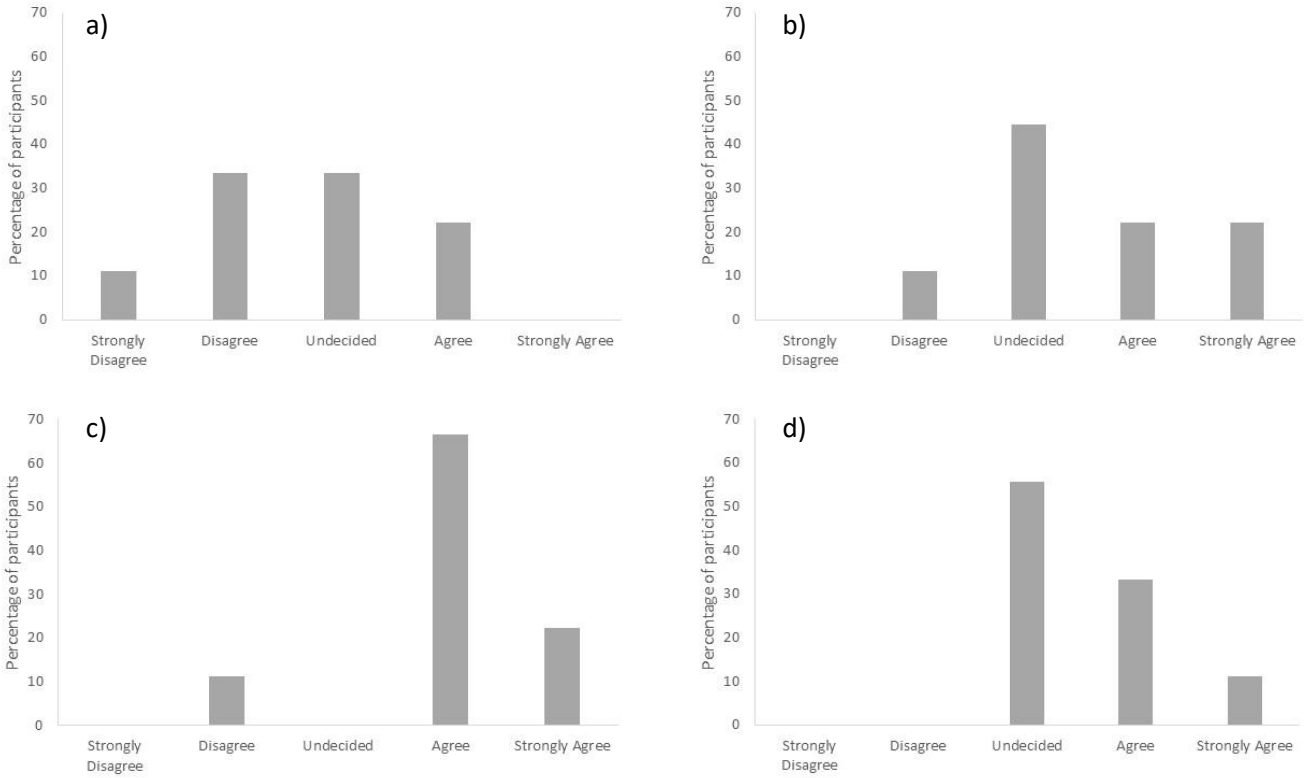

Figure 1.

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441 **Table 1.**

Higher-order themes	Lower-order themes	Meaning units (M.U.)	Number of sources
Adherence	Habit forming and behaviour change	19	5
	Non-adherence consequences	10	8
	Adherence inhibitors	12	8
	Adherence promoters	16	9
	Subtotal	*57*	
Athlete Approach	Negative reflectivity and ownership	31	9
	Positive reflectivity and ownership	11	8
	Wellbeing definition and impact	28	9
	Monitoring process influences scoring	4	4
	Subtotal	*74*	
Education and Awareness	Lack understanding of monitoring	26	8
	Demonstrates understanding of monitoring	12	5
	Subtotal	*38*	
Feedback and Act	Effective examples	38	8
	Ineffective examples	58	9
	Athlete feedback preferences	18	9
	Subtotal	*114*	
Planning and Design	Additional monitoring	11	9
	Suggested improvements	32	9
	Perceived sensitivity of questions	13	9
	Technical & Equipment issues	12	6
	Subtotal	*68*	

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443

444 **Figure 1.** Questionnaire responses by athletes indicating the strength of their feelings towards the
445 following questions: a) “I receive sufficient feedback from the data I enter into AER,” b) “When there
446 are meaningful changes in my TM scores, action is taken.” c) “I respond honestly to TM questions,”
447 and d) “TM and feedback helps optimise my training and performances.”

448
449 **Table 2.** The total number of meaning units and athlete sources attributed to the data themes
450

Appendix A

Please rate and circle the extent to which you agree with the following questions:

1. I feel I have received sufficient support and education to enable me to understand the reasons for training/wellbeing monitoring

1	2	3	4	5
Strongly Disagree	*Disagree*	*Undecided*	*Agree*	*Strongly Agree*

2. Training/wellbeing monitoring and feedback has helped improve my understanding of my wellbeing.

1	2	3	4	5
Strongly Disagree	*Disagree*	*Undecided*	*Agree*	*Strongly Agree*

3. The questions posed in training/wellbeing monitoring are sensitive to changes in my wellbeing.

1	2	3	4	5
Strongly Disagree	*Disagree*	*Undecided*	*Agree*	*Strongly Agree*

4. I can identify a meaningful change in my training/wellbeing scores.

1	2	3	4	5
Strongly Disagree	*Disagree*	*Undecided*	*Agree*	*Strongly Agree*

5. When there are meaningful changes in my training/wellbeing scores (as determined by either myself or my coach/multi-disciplinary team) action is taken e.g. performing modified training.

1	2	3	4	5
Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree

6. I respond honestly to training/wellbeing monitoring questions.

1	2	3	4	5
Strongly Disagree	*Disagree*	*Undecided*	*Agree*	*Strongly Agree*

7. Training/wellbeing monitoring and feedback helps optimise my training and performances.

1	2	3	4	5
Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree

8. I receive sufficient feedback from the data I enter into training/wellbeing monitoring forms. (Feedback could be in any form, such as a presentation, discussion, dashboard on the monitoring app e.t.c)

1	2	3	4	5
Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree

9. Completing training/wellbeing monitoring is a burden on my time.

1	2	3	4	5
Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree

10. I will continue to use some form of self-monitoring tool in the future.

1	2	3	4	5
Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree

Appendix B

Interview Guide

1. What is your definition of athlete wellbeing?
    a. How can wellbeing affect your ability to train/perform?
2. Why do you think you are being asked to complete training/wellbeing monitoring?
3. What expectations of training/wellbeing monitoring did you have?
4. Do you think training/wellbeing monitoring helped your training and performances?
5. Do you feel the training/wellbeing questions we are asking are sensitive to changes in your wellbeing?
6. Do you feel you answer the training/wellbeing questions honestly?
7. What questions do you think we could include to better understand and monitor your wellbeing and response to training?
8. Do you feel you received enough information and feedback from the data you entered?
    a. How would you prefer to receive feedback? (what format, frequency etc)
9. Do you think you would be removed, or perform modified training as a result of red flags or meaningful changes in your wellbeing data?
10. Did you consistently fill in training/wellbeing monitoring during the last season? (Yes/No)
    a. Where there certain days or time-points where you stopped completing training/wellbeing monitoring?
11. Are there consequences when your wellbeing data is not completed?
12. What were the drawbacks (if any) of using training/wellbeing monitoring?
13. What recommendations do you have for improvement of training/wellbeing monitoring in the future?
14. Would you like to continue to use some form of self-monitoring tool?
15. Are you doing any additional monitoring outside of training/wellbeing monitoring?
    a. What additional monitoring are you doing? (If any)